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SCIENCE AND SOCIOLOGY

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ABSTRACT

The scientific achievements of sociology have been disappointing. Sociology is properly a utilitarian science. *The five methods of sociology.*—In it five inductive methods of seeking truth may be considered. The common-sense method, consisting in generalizing from data which chance to come to hand, has been the most prominent. The historical method uses documents as its data. The museum or census method, having classification as its goal, has been used extensively in social surveys and government investigations. The laboratory or experimental method is restricted in sociological research by the length of time required for social experiments, by the number and complexity of the variables involved, and by the difficulty of controlling human variables. *Superiority of the statistical method.*—The statistical method consists in applying rigidly objective methods, aided by mathematics, to the interpretation of the social phenomena which spontaneously occur. In the form of simple comparisons the method has been widely used, but its value has been limited by the lack of comprehension of the method even in its crude form, and by the failure of crude comparisons to answer adequately the questions involved. Partial correlation and regression meet the needs of social research by furnishing predictions of stated variables in terms of other measured or classified variables, and by indicating the importance of the variables not considered. The development of reliable indices for certain social variables is prerequisite to the solution of fundamental sociological problems by statistical methods.

Sociology has aspired to call itself scientific ever since Comte coined the word and set sociology at the apex of his hierarchy of sciences. It has been characteristic of sociologists to state impressively the scientific ideals which should control their researches. Comte devotes a major part of his *Positive Philosophy* to reviewing the unscientific nature of the theological and metaphysical stages through which human thought in general and the study of society in particular passes, and announces impressively the revolutionary results which are to follow upon the application of positivistic methods to social research. Spencer takes great pains to demonstrate that the principles of evolution hold good of social phenomena. Ward's discussion of the characteristics of the scientific method and its application to sociology creates in the reader at first an enthusiastic expectation that human relationships are at length to be analyzed on a strictly objective basis and that

a valid and usable science of human welfare is to arise. Giddings and Small both devote a great deal of attention to the discussion of scientific methods and succeed in creating this same expectation that a solid science of society is to develop.

These expectations have not yet been fulfilled. Ward, in connection with his review of the work of Comte and Spencer, announces the sterility of all sociology which preceded his own.¹ In spite of the work of Ward subsequent writers appear to continue skeptical with regard to the scientific achievements of sociologists preceding themselves. Even Giddings, who takes a very sympathetic view of the work of his predecessors, says: "I hope that most of the readers of this volume will be able to see that much sociology is as yet nothing more than careful and suggestive guesswork; that some of it is deductive; and that a little of it, enough to encourage us to continue our researches, is verified knowledge."²

Small says that the interpretations of social scientists have been "pitifully superficial, fragmentary and incoherent,"³ and he elsewhere speaks of "the thinness and inconclusiveness of nearly everything which has hitherto passed as social 'science.'"⁴

If sociology had succeeded in becoming scientific it would be expected that some degree of unanimity would have begun to appear in the conclusions of the various writers. Unanimity is strikingly absent. Ward enumerates eleven fundamentally different conceptions of sociology and then proceeds to adopt a twelfth as his own.⁵ Lack of unanimity in conclusions has been even more striking. The radical differences of opinion between Comte and Ward on the proper status of women, and between Ward and Spencer on the desirability of war and of public education, are classical examples.

In recent sociological literature there is perhaps an increasing agreement as to the scope, fundamental problems, and tentative

¹ *Dynamic Sociology* (1897), I, xxv.

² *Principles of Sociology* (1909), p. xvii.

³ *Meaning of Social Science*, p. 147.

⁴ *American Journal of Sociology*, XXVII (1921), 94.

⁵ "Contemporary Sociology," *Amer. Jour. Sociol.*, VII (1902), 475-500, 629-58, 749-62.

conclusions of sociology,¹ but one seeks in vain for any such definite, firmly established, and useful results as, for example, the laws of refraction of light, or the germ theory of the transmission of typhoid fever. The scientific method in sociology is an aspiration rather than a realization, and concrete results of the positivistic methods heralded by sociologists in the past are disappointing. Perhaps it may not be too presumptuous to attempt to review the elements of scientific procedure in order to discover if possible the reasons for the failure of sociology to fulfil the promises of those who have sought to make it a science.

The distinction between "pure" and "applied" sociology is fundamental to the present discussion. If the motives of sociological research are primarily intellectual curiosity and the passion for systematization, the methods pursued are likely to be fundamentally different from those required if social science is considered not as an end in itself but as a means to the direct solution of practical problems. While it is obvious that these two types of motive interact and supplement each other, it is equally true that sociology, in its ultimate motivation at least, has been strongly utilitarian. Comte states the purpose of science as being to predict in order to control.² Ward says that a science which does not benefit man is a dead science, and that the winning of the power artificially to modify phenomena is the only practical value which science has for man.³ Carver says, in discussing the purpose of the study of sociology, that social improvement is the only worthy aim of the student.⁴ Ross says: "Sociologists follow the methods of Science, but they are by no means content to seek Knowledge for her own sake. They are not ashamed to avow an over-mastering purpose and it is . . . to better human relations."⁵

Strikingly enough, "applied" sociology does not consist to any great extent of the application to social problems of the generaliza-

¹ Bushnell, "Scientific Method in Sociology," *Amer. Jour. Sociol.*, XXV (1919), 41-58.

² Comte, *op. cit.*, p. 61.

³ *Dynamic Sociology* (1897), I, xxvi, xxvii.

⁴ *Sociology and Social Progress*, p. 2.

⁵ *Principles of Sociology*, p. vii.

tions reached in theoretical sociology, but it is built up independently on the basis of the experience of social workers, the results of social surveys, and the analysis of social statistics. Probably the most striking exception to this rule is the attempt of socialists to build up a practical social order on the basis of the theorizing of Marx and other doctrinaires. Robert Minor finds justification for the policies of Lenin in the conclusion of Engels that the state has its origin in the institution of private property, and hence that the only road to the abolition of the state lies through communism.¹ Most sociologists however take the theories of ethnology much less seriously than this, and close the book of social theory before they open the volume of applied sociology. This seems to the present writer an eminently sound procedure. The question whether communism is a practicable and desirable form of social organization must be decided, not on the basis of the prehistoric origin of the state, but on the basis of whether present human needs can be better served by a condition of communism than by any other form of society.

If sociologists were seriously to adopt the utilitarian point of view, it would mean a tremendous change of emphasis in social research. Instead of being absorbed primarily in social origins and philosophical generalizations as to the basis of human association, the social scientist would bend his major energy to the solution of specific problems related to human happiness as conditioned by the social environment of man. The objectives of pure sociology may be stated as the development of a logical system of theories which shall most completely explain the origins, the evolution, and the current phenomena of social relationships. The objectives of applied sociology may be stated as the discovery of socially practicable means for minimizing undesirable social conditions and for maximizing desirable social conditions. Social theorists are prone to defend pure sociology on the assumption that it is the surest road to the achievement of the ends of applied sociology. The present writer, on the contrary, maintains that not only has social theory proved fruitless for the ends of social betterment, but that the achievement of the rational system of social theory sought by pure sociology can be greatly promoted by means of the direct

¹ *The Liberator*, October, 1920, pp. 6, 11.

attack on social problems. He frankly avows a dominant interest in social welfare and in research for directly useful ends clearly envisaged at the start.

What scientific methods then are available for the discovery of socially practicable means for minimizing undesirable social conditions and maximizing desirable social conditions? The writer proposes to classify under five heads the more or less scientific inductive attempts to arrive at truth: namely, the common-sense method, the historical method, the museum or census method, the laboratory or experimental method, and the statistical method. The past use of each of these methods by sociologists, and their availability for promotion of the ends of sociology as defined above, will be discussed briefly below.

The common-sense method may be defined as generalization on the basis of whatever experience, information, and tradition chance to come to hand. It might be called the armchair method, or the casual method. The person who uses it builds up his theories and his conclusions by means of pondering upon the occurrences which have happened to come under his personal observation, or to have been described in his reading or conversation, utilizing the results of the thinking of writers and scientists whom he has studied, or with whom he has come into contact.

This method, if such it may be called, consists simply in carrying on a little more extensively and intensively than the average man does, the ordinary mental processes. The five steps in scientific investigation may be stated as definition, classification, measurement, enumeration, and correlation. The mind is a mechanism for performing these five functions in a proximate fashion, and, conversely, these processes are merely refinements of ordinary mental acts. The child early begins to perceive differences between his sensation complexes, and thus has embarked instinctively upon the process of definition. A little later likenesses begin to be observed, and thereby the rudiments of classification have been achieved. Everyone acquires the ability to estimate more or less approximately the size of objects, the intensity of their characteristics, and the speed and direction of their movements, and so performs rudimentary measurements. Everyone

learns to approximate the number of certain types of objects with which he comes into contact, and thus carries out rudimentary enumerations. Everyone learns by habit to observe the repeated sequences and groupings of ordinary events, and so engages in rudimentary correlation. In these senses everyone is a rudimentary scientist. Science consists merely in introducing accuracy, impartiality, and generality into these ordinary mental processes.

To indulge in a bit of casual estimation, the writer would judge that over three-fourths of the books in the average library are the products of the common-sense method. Surely the proportion is no smaller than this among sociological writings. The casual observer may be a man or woman of wide experience, of broad reading and study, of extensive travel, of logical mind, and of brilliant capacity for generalization. In proportion as he or she has these qualities the resulting output will be of interest and value.

The dangers of the common-sense method are too obvious to require emphasis. The usual crudeness of the definitions employed, and of the classifications, measurements, enumerations, and correlations made, opens the door wide to logical fallacies. Moreover, selective errors are introduced in a variety of ways. In order to generalize soundly upon casual experience it is necessary to be certain that that experience is a fair sample of the data with regard to which the generalizations are made. This, however, is not likely to be the case. First, the events and objects presented to a given individual are not likely to be a fair sample. Secondly, the individual himself selects from the accessible materials the data which interest him. Thirdly, when the individual gets to formulating his theories, the items which fit his hypotheses recur to his memory, while conflicting data are likely to be forgotten or subordinated. Hence the data upon which the casual thinker generalizes are quite unlikely to be a fair sample.

As safeguards against these grave drawbacks in the common-sense method the chief resources are critical comparisons between independent studies and a checking of theories against facts. If different students independently arrive by casual methods at similar conclusions, the weight to be attached to the results is greatly increased. If the inquiries are not really independent,

however, agreement may indicate simply a copying of errors. Failure to approximate the same results on the part of independent students of similar problems indicates fallacious thinking on the part of one or both. The lack of any large body of sociological truth verified and accepted by independent students is strong evidence against the soundness of the bulk of sociological thinking.

If it is possible to check the conclusions of casual thinking against impartially selected facts the results are capable of proof or disproof. To do this usually involves, however, the use of the more strictly scientific methods described below. The absence of any adequate checks upon most theorizing is a great social weakness.

It should be acknowledged in passing that the present paper is a product of the common-sense method. The ultimate test of its value will be the results achieved by the methods which it proposes.

Deductive reasoning must of course be used in conjunction with any of the inductive methods. The tremendous liability to logical fallacy, however, places deduction in a class closely related to the casual method. The conclusions of logic are of value only when closely checked by criticism and experiment. The chief function of the common-sense and deductive methods is to provide hypotheses to be tested out by more rigorous scientific methods.

The historical method is characterized by its use of documents as its basic materials. The documents used are almost entirely the result of the common-sense method as applied by contemporary observers. That is to say, they are the records of the experiences, the acts, and the observations of individuals not attempting rigid definitions, classifications, enumerations, measurements, or correlations, and not seeking to make exhaustive investigations. In some cases—particularly in connection with legal documents—considerable accuracy may be predicated of the data involved, but in proportion as comprehensiveness and precision are introduced into the original documents the method ceases to be typically historical and becomes more properly classifiable under the museum or statistical methods. Although based upon casual materials, the historical method is a great advance over the casual method in that the attempt is made to take into account all of the pertinent

documents in arriving at conclusions. If the historian is open-minded and industrious, he may eliminate much of the error of his original materials by comparisons of the observations of independent students. If he is biased by patriotism or prejudice he may, of course, introduce his own errors of selection into his results.

Even with the best intentions, however, certain handicaps are inherent in the historical method. The original documents tend to be selective in the data which they report, for they reflect for the most part the viewpoints of the educated and privileged classes and are colored by the superstitions, prejudices, and limitations of the times when they were written. The casual observers who produced the documents on which history is based were for the most part unable to observe with complete impartiality, because of their lack of training and of scientific information. They did not know what to look for or where to find it. Modern historians have been developing technique for guarding against these errors.

It is a development of the historical method which Small has suggested as the ideal procedure in sociological research. His plan would be for a group of specialists in the various social sciences all to investigate concurrently the same historical epoch, such, for example, as the French Revolution.¹ The method used by Thomas in *The Polish Peasant in Europe and America* is perhaps allied more closely to the historical than to any other of the methods listed above. Its scientific value testifies to the rich rewards awaiting the student who is willing to collect and compare social data systematically and impartially. Such work is useful to the degree that it is precise in definition, that it gathers impartially all pertinent data, and that it discovers the degree and significance of the correlations between the variables involved. Any procedure which adds accuracy, impartiality, and comprehensiveness to the processes of definition, classification, measurement, enumeration, and correlation, promotes progress toward scientific methods.

The museum or census method, as herein defined, is concerned primarily with definition, classification, and enumeration of items. Many of the biological sciences proceed chiefly by the museum method. Geology and paleontology utilize it extensively.

¹ *The Meaning of Social Science*, pp. 156 ff.

In the social sciences the museum method has been strongly in evidence in ethnology and anthropometry. The great bulk of sociological statistics, including the United States census and many other government reports, may be classified under this head, since their chief end is description, classification, and enumeration. Social surveys have frequently furnished examples of this method. Some social surveys attempt to establish correlations but they do so chiefly by common-sense methods.

From the standpoint of pure science doubtless the work accomplished by the museum method appears to be worth while for its own sake. From the standpoint of utilitarian or applied science the classifications of the museum and of the census can be justified only in so far as they facilitate the higher purpose of correlation—of developing scientific laws through which phenomena may be controlled for human ends, or through which human conduct may be better adjusted to the uncontrollable phenomena of nature.

The laboratory or experimental method has two fundamental characteristics: first, the development of apparatus for the accurate observation, measurement, recording, and enumeration of data; and second, the development of methods for controlling all variables except the one under investigation. Illustrations of the apparatus developed in the laboratory occur in profusion: micrometers, microscopes, telescopes, microphones, minutely accurate weighing scales; delicate instruments for measuring heat, electrical current, earthquake shocks thousands of miles away, the intensity of light or the pressure of blood in human arteries; kymographs for recording automatically various types of pulsation; the moving picture and the phonograph for recording sights and sounds; the calculating machine, and the assorting and tabulating machines—these and innumerable other instruments illustrate the development of laboratory apparatus for eliminating the shortcomings of the human sense organs and nervous system as the instruments for measuring, recording, classifying, and enumerating data.

The laboratory method of studying the correlation between two variables by keeping all other pertinent variables constant may be illustrated by the procedure of an engineer interested in the effect of lime upon the characteristics of concrete. In order

to study the matter he carried out several thousand experiments in which the other variables which affect the qualities of cement, such as the richness of the mixture, the fineness of the gravel used, the conditions under which the concrete hardened, and the like, were kept constant at various combinations while the proportion of lime was varied. From the resulting data it was possible to say that under specified conditions lime in specified quantities has a certain accurately determined effect upon the qualities of concrete. This, of course, is the typical laboratory procedure—to control the variables involved in a problem, and to observe the changes which occur in one variable with given changes in a second variable when all other pertinent variables are kept constant at known intensities.

It is the laboratory, or experimental, method, doubtless, which stands out most clearly in the mind of the average man when he thinks of science. This method has been the basis of the much heralded scientific triumphs of modern times. The Industrial Revolution started with inventions which resulted from experimental research, and modern industry, whether in manufacturing, mining, agriculture, or transportation, depends upon the findings of the chemical, engineering, metallurgical, agronomical, or electrical laboratory.

Not only in its effects but also in its origins the laboratory method has been largely utilitarian. In its rudimentary state, of course, the method did not imply the possession of the accurate instruments and highly controlled conditions of modern times. The primitive laboratory was quite likely to be a woodshed or a rear lot. In its essence experimentation arises from the trial-and-error method which is instinctive not only in human mental processes but in the reactions of mice, chicks, guinea pigs, and even angleworms. Indeed, the amoeba, thrusting out experimental pseudopodia, is engaged in rudimentary scientific investigation of its environment. The amoeba, moreover, is more scientific than many a human student, for the amoeba sticks closer to the facts and avoids the logical errors of generalizations from biased data.

Sociology, unfortunately, can take relatively little advantage of the laboratory or experimental method. This is the case for

three principal reasons: First, experiments in human welfare often take so long that progress is infinitely tedious. One would have to wait a lifetime, in many cases, in order to get the results of a single experiment. Second, the number of variables is so great that it is exceedingly difficult to be sure that uncontrolled factors are not responsible for the results. Is the present great Russian experiment in communism, for example, a failure (if it is a failure) because its economic theories are unsound, or because of the allied blockade and the fostering of wars against her on the part of Poland and other countries? Or is it a success (if it is a success) because its economic theories are sound, or because the extraneous factor of external aggression amalgamated the people in spite of the economic complexion of the government? Questions of this sort inevitably arise in connection with the Social Unit Experiment, Helicon Hall, the Amana Community, or any other sociological experiment.

The third reason for the relative unavailability of the laboratory method in sociology is that human nature makes the control of many of the variables related to human welfare impossible. It is socially non-feasible, for example, to carry out experiments in human breeding. It is extremely difficult to control the liberty of any individual so successfully as to be sure that he or she is conforming to the conditions of a given experiment.

For the foregoing three reasons social science, if it is to experience the tremendous progress and development which have attended the introduction of laboratory procedure into such sciences as physics, chemistry, bacteriology, and psychology, must have recourse to some method which offers the precision, objectivity, and universality of the experimental method under the conditions involved in social research. These requirements are met by the statistical method.

In connection with the suggestion of statistics as the scientific method for sociology it should be observed that Comte and Ward both averred the impracticability of reducing social data to mathematical terms, which is exactly what it is proposed herein to do. As contrasted with Comte and Ward, Giddings in his definition of sociology refers to it as a "science statistical in its method."

The statistical method, as defined herein, involved characteristically the study of the correlations between socially significant variables by means of the comparison of groups of data which can be objectively measured or classified, but cannot readily be controlled for experimental purposes. For example, the number of arrests is not readily subject to experimental control, but it is subject to measurement in conjunction with other variables of sociological interest. The student of delinquency may compare the number of arrests per one thousand of colored population with the number per one thousand of white population, or the rate of arrests among unskilled laborers with the rate among skilled workers, or the rate under prohibition with the rate when the sale of intoxicants was legal, or make any number of an indefinite variety of similar comparisons. If the number of items involved is sufficiently large it is possible to determine by such comparisons the extent to which, under the conditions obtaining in the sample collected, arrests tend to be more or less frequent among colored persons than among white persons, or among the unskilled than among the skilled, or under a state of liquor license than under prohibition.

The foregoing method of statistical comparison has been quite widely used in the investigation of social problems. In the field from which the illustration is taken it has been used extensively by the Aschaffenburg and others.¹ It is based directly upon the recognized canons of logic. For two reasons, however, the statistical method has not been widely successful in placing social investigation upon a soundly scientific basis. First, a large proportion of persons engaged in social investigations do not understand the use of the method, even in the crude form described above. Second, the crude method is not adequate to the scientific solution of social problems.

Very few investigations in sociological statistics bear evidence of a thorough understanding of the statistical method. One frequent error is for the investigator to analyze each case in his investigation, determined by casual methods the causes for the maladjustment, and then tabulate these causes as though they had

¹ *Crime and Its Repression.*

been objectively determined. For example, it used to be customary in the reports of charitable organizations to have the investigators decide relative to each family whether the cause of the distress was alcoholism, shiftlessness, sickness, inadequate earnings, or some other factor, and then state that such and such proportions of the poverty dealt with were due to alcoholism. It is obvious that if the investigators were ardent prohibitionists, the number of cases assigned to alcoholism would be larger than if they were moderate drinkers. In other words, the arbitrary assignment of "causes" by the investigators introduces the errors of the casual method. Healy's study of one thousand individual delinquents is based upon this method.

A second very frequent defect is to demonstrate that a certain percentage of persons maladjusted in a given way have a certain characteristic, and then to assume that the two conditions are correlated without ascertaining what proportion of normal individuals have the same characteristic. The study by Breckinridge and Abbott of the *Delinquent Child and the Home*, though admirable in many ways, describes in great detail the characteristics of the environment of the delinquent child, but makes few, if any, comparisons between these conditions and those of non-delinquent children. For instance, the book states that a certain percentage of delinquent children come from broken homes, and creates the impression that this is a cause of delinquency, without ascertaining what percentage of non-delinquents of similar ages come from broken homes. Similar failure to establish normal controls on the abnormal types studied appear in a very large proportion of the statistical studies of social problems.

If such errors as those just discussed are avoided, the use of even crude statistical methods gives results vastly more reliable than the use of the casual method. Crude statistical comparisons, however, have three defects which limit their usefulness to social science. First, a simple statistical comparison usually implies the unjustified assumption that other factors than the two variables considered in a given comparison are constant. When the investigator of criminology studies the relationship between rate of arrests and color he is likely to conclude that "other things being equal, colored persons are more likely than white to be arrested."

The difficulty is that other things usually are not equal. The colored man is much more likely than the white to be an unskilled laborer, to live under conditions of poverty, to be poorly educated, to be diseased, and to live in congested and insanitary dwellings. All of these factors probably predispose to delinquency, and it may be true that the tendency to crime which the investigator ascribes to racial factors is due simply to the adverse economic and social conditions under which the negro is compelled to live. A striking fallacy of this type is the crude conclusion that foreign-born persons are very much more prone to crime than native-born. It happens that the foreign-born are concentrated chiefly in the age and sex groups from which arrests come. If the number of arrests per one thousand males twenty to forty-four years of age is compared for native and foreign groups, the contrast is greatly reduced if not eliminated.

The most obvious method of dealing with this source of error is to subdivide the data. For instance, the rates of arrest for colored and white might be calculated separately for each occupational group, or the rates for native and foreign by each age group. The difficulty here is that, unless the amount of data is unlimited, the numbers in the subgroups very soon become too small for reliable generalization. It is not sufficient ordinarily to subclassify merely according to two or three variables; in order to be certain of results by this classification method, it is necessary to have a subclass for every combination of the variables involved. Even with so simple a classification as that involving white and negro, native and foreign, five occupational groups, four age groups, and two sex groups, there would be 120 subdivisions of the data. In order to get enough items into each compartment of this classification to generalize with any safety, tens or hundreds of thousands of items would have to be collected. The resulting tabulations, moreover, would be so complicated as to make interpretation difficult. Reports of many of the governmental commissions illustrate the expense involved in this procedure and the difficulty of deriving clear conclusions.

A second difficulty with the simple statistical comparison of classified data is that even when a connection has been demonstrated between two variables, such as poverty and infant mortality,

the method furnishes no direct indication as to the relative importance of poverty and of other known factors, such as ignorance, impure milk, defective heredity, or of unknown variables.

The third difficulty is the absence of an accurate method of determining how closely the results of a given limited investigation probably approximate the results which would have been obtained if the study has been continued indefinitely.

To meet just such difficulties as these the theory of correlation and regression has been developed. The factors determining the number of arrests in a given community might, for example, be studied by means of the correlations between such indices as the following: A = the number of male arrests per one thousand males over fifteen years of age; C = the proportion of colored persons among males over fifteen years old; F = the proportion of foreign-born persons among such males; and U = the proportion of unskilled workers among males gainfully employed. By taking a large number of areas, such as cities or police districts, ascertaining these indices for each district and calculating the partial regression equations, the relationship between the variables referred to could be stated in a formula as follows:

$$A = k + b_{ac}C + b_{af}F + b_{au}U \pm e,$$

where K is a constant, where b_{ac} , b_{af} , and b_{au} are respectively the amounts of difference which may be expected in the rate of arrests corresponding to units of difference in the percentages of colored, foreign-born, and unskilled laborers respectively when other factors are kept constant, and where e represents the probable error of the prediction. In other words, this equation is a mathematical formula for the best prediction of the rate of arrests on the basis of the other indices, and of the probable reliability of the prediction. The formula would show how much of a decrease in the number of arrests could be expected if foreigners or negroes were excluded from the community, or if economic conditions associated with a low scale of living were eliminated.

This sort of formula is known by statisticians as a rectilinear partial regression equation. It should be noted that every scientific law is expressed in a form allied to a regression equation. Every

scientific law states the best prediction of a variable in terms of one or more other variables. The law of gravitation, for example, states the amount of attraction between two bodies in terms of their mass and distance from each other. Not all scientific laws can be expressed in mathematical terms, and relatively few of them can be expressed in rectilinear equations, but all of them do predict certain variables in terms of other variables.

The purposes of applied social science have been stated earlier in this paper as the minimization of undesirable social conditions and the maximization of desirable social conditions. Desirable and undesirable conditions are not often, however, subject to direct social control. For instance, the community cannot directly control the infant-mortality rate, but it can control conditions correlated with infant mortality, such as purity of the milk supply, the prevalence of poverty, or the employment of nursing mothers. The statistical method of approaching the purposes of social science is therefore to develop by means of regression equations or of equivalent methods formulas stating the amounts of change in given desirable or undesirable social conditions which accompany given changes in other conditions correlated therewith which are subject to social control. If these formulas are perfected to such a degree that the error of estimate approaches zero, the formulas indicate directly the steps most likely to bring about the desired increase or decrease in the social condition considered, whether that condition be delinquency, infant mortality, church membership, labor turnover, or appreciation of music.

The use of partial correlation presupposes accurate, objective, and comprehensive methods of defining, measuring, classifying, and enumerating the items involved. No insuperable difficulties prevent accurate definition of sociological items and variables. The United States census, for example, has developed scientific definitions of such terms as "family," "age," and "occupation," and has evolved rules for classifying individuals in its enumerations. The problem of accurate measurement is a far more difficult one. How, for example, may one measure the amount of crime in a community, the amount of disease, the quality of the housing, the character of parental training, or even such an apparently

simple variable as the economic status of a family? Just as the progress of electrical theory was dependent upon the development of delicate instruments for measuring current, and the development of scientific psychology was dependent upon the development of accurate and objective apparatus and methods for measuring mental and neural reactions and characteristics, so the progress of scientific sociology depends upon the development of accurate and objective methods of measuring the variables significant in sociological problems. It may be worth while to review briefly some of the more important of these variables, with suggestions as to the methods whereby it might be or has been attempted to measure them.

Economic status is a fundamental variable in social research. Work already done indicates that economic status is correlated with delinquency, school retardation, elimination from school, infant mortality, tuberculosis, bad housing, prostitution, and other significant social conditions. Probably the best measure of economic status would be the total family income per adult unit for a given period, modified by some index of the skill of the family in spending. Such data are difficult to get because of the reluctance of families to disclose the information, and because of the accounts which must be kept in order to make the returns accurate. Other possible indices of the economic status are the earnings of the father, the wages of the father, the occupation of the father, the amount of rent per person paid by the family, or the ownership or non-ownership of the home.

The intelligence and education of the individuals involved in a sociological investigation is a second important item. For children attending school a standardized index of the degree of retardation is valuable in this connection. For those who have left school the age and grade of leaving are correspondingly important. Where tests given by trained experts are available the intelligence quotient, or equivalent index, is fundamentally significant. More difficult to get at, and not easily reducible to quantitative terms, is the fact of feeble-mindedness or pronounced mental abnormality among near relatives of the persons involved.

The degree of socialization—meaning by socialization the capacity and tendency of the individual to adopt as his own the interests of the social groups to which he belongs—is a fundamental variable in sociological research. The habitual criminal obviously is an individual of very defective socialization. The true patriot, on the other hand, is presumably a highly socialized person. Individuals deficient in socialization are liable to become profiteers, unjust employers, grafting labor leaders, political spoilsmen, deserters, parasites, criminals, or other types of undesirable citizens. Highly socialized individuals, on the other hand, are likely, if competent in other respects, to become good parents, faithful employees, philanthropists, statesmen, civic leaders, or other types of desirable citizens. The characteristic of socialization is probably no more complex than the quality known as “general intelligence,” and presumably it is capable of objective measurement. The development of a reliable objective index of this quality is one of the urgent needs of social science. Experiments in this direction are being conducted by the writer.

These three indices are typical of those needed for the development of the correlation method of studying sociological problems. Among sociological variables for which fairly reliable indices are already available are age, sex, color, rural-urban distribution, migration, and marital condition. For fecundity the number of children in a community per one thousand women of childbearing age is fairly satisfactory, though accurate statistics of births are greatly needed. Death-rates are becoming available in a rapidly increasing area of the United States. For physical condition the height-weight coefficient is valuable in conjunction with other data as to physical defects. Among variables for which indices are in process of development are housing and neighborhood conditions, hereditary background, and recreational interests. An individual characteristic of unappreciated social importance is nervous energy; an index of this characteristic is badly needed.

It must not be assumed that the statistical method of correlation is available only where the variable is capable of quantitative measurement. The method is applicable to non-measurable

characteristics such as sex, nativity, occupation, and color. Yule has developed the theory of such correlation at some length in his text on the *Theory of Statistics*.

Statistical technique is not, of course, an automatic method of ascertaining truth, nor does it eliminate the necessity for common sense, scientific insight, or laborious research. Correlation is merely a development in mathematical terms of the principles of logic. It vastly reduces the probability of many of the most serious logical fallacies, but it is far from a fool-proof mechanism, and it has dangers of its own. The following conditions, among others, must be observed in the use of this method:

1. Constant or cumulative errors in the selection, measurement, and treatment of data must be especially avoided.

2. It is essential to stick close to the original data. It should not be assumed that a given index means more than its actual content implies, unless broader meanings are proved by correlation.

3. Mathematical complexity in indices is likely to introduce spurious correlations.

4. Correlations cannot safely be established, especially when partial correlations are used as suggested above, unless a fairly large number of impartially selected items or cases are used.

5. As wide a variety of conditions, times, and places as possible should be represented among the items studied. Predictions based on correlations are valid only within the range of conditions represented by the items on which they are based.

6. Low correlations are of value chiefly as indicators for further study. Unless high coefficients are determined, important variables not measured in the investigation are involved in the problem.

7. Rectilinear correlations are based on the assumption that a constant ratio exists between changes in the subject and relative variables. This is often not the case. For example, a difference of \$100 in family income corresponds with a much greater difference in infant-mortality rates at the lower end of the income scale than at the upper end.

The backwardness of social sciences has not been due to any insoluble complexity of the data—ponderous opinion to the contrary

notwithstanding. Our failure to achieve results has been caused by the lack of objective means of measuring certain important variables, and the failure to apply and develop scientific methods of generalizing from social data. When these handicaps are overcome social science may be expected to produce improvements in human life far more revolutionary than those resulting from the application of experimental methods to physics, chemistry, and medicine.